Introducing Cold-hardy Kiwifruit to Minnesota

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Project Summary

The goal of this project is to introduce Minnesota growers to kiwifruit and provide them with information about the culture and management of growing this tasty and nutritious cold-hardy crop using two trellising approaches, pergola and T-bar, that prevent soil erosion, conserve soil moisture, and integrate natural biological measures. Articles in previous editions of the *Greenbook* described our activities in year one and year two of the project. This article provides the information about how to build a pergola system for kiwifruit or grapes.

Project Description

Cold-hardy kiwifruit is a deciduous vine that produces small, delicious, smooth-skinned berries and deserves greater attention in Minnesota. Kiwifruit are native to eastern Asia; there are about 70 different kiwifruit species. The most cold-hardy is *Actinidia kolomikta*, sometimes referred to as "Arctic Beauty" due to its colorful tri-color leaves. Native to Siberia, this particular species performs well throughout Minnesota when its cultural considerations are met. *A. arguta*, another species of merit, has a more vigorous growth habit, is sun-tolerant, and can be grown in southern Minnesota where winter temperatures are not expected to fall below -23°F. Kiwifruit prefers well-drained, silty soil that contains ample organic matter and retains moisture. The plants perform best in a partially shaded and sheltered location that provides protection from both late afternoon winter sun and strong summer winds. Generally the east side of a windbreak will satisfy the shade and wind protection conditions, but shallow tree roots may compete for soil moisture and nutrients during the growing season. The site should also have good air movement to avoid damaging frost pockets.

The University of Minnesota Horticultural Research Center (HRC) in Victoria, MN has been growing cold-hardy kiwifruit on a T-bar trellis since 1988 (Figure 1). However, for cold-hardy kiwifruit production, a pergola (horizontal trellis) structure offers several advantages over a T-bar (for kiwifruit and other vining fruit like grapes) including reduced vine stress, suckering, and weed growth because of the self-shading effect of the vegetative canopy. Other advantages include improved fruit appearance (due to less wind rub of skin), ease of harvest (the berries are easier to pick), ability to accommodate hilly terrain, and a cooler place to work on hot summer days.

[1] *Trellis system illustration used with permission of the Oregon State University Extension Service from page 10 (figure 1-A) of publication PNW 507, Growing Kiwifruit (reprinted April, 2005, Corvallis).*

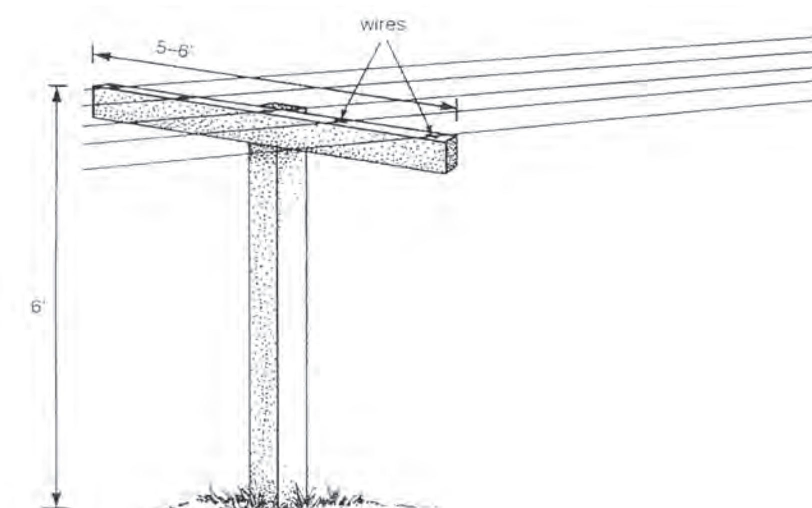
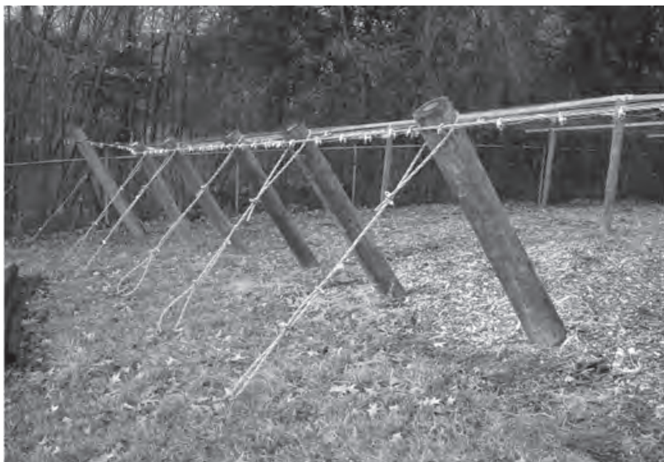


Figure 1. Standard T-bar trellis system for kiwifruit.[1]

Figure 2. The north-south pergola at the HRC runs along a hillside.

Figure 3. One 12' corner post and five 10' end posts (L to R). The posts are held in position using earth-anchor tie backs set opposite of the direction of pull.



For part of this project, we constructed a demonstration pergola at the HRC. Little information about how to construct a pergola is available, so we are including a large amount of technical information in this article. In 2009 dollars, the estimated material cost on a per acre basis was approximately $15,000.

A second part of this project was led by farmer-cooperator, Eric Theship-Rosales, who is constructing terraces and using trees as supports for kiwifruit on his steep acreage. His work is described toward the end of this article.

HRC Site Overview

The pergola trellis at the HRC is oriented north-south and measures 48' wide by 250' long. However, dimensions can be readily adjusted to accommodate available space. (One of the project partner's wooden-framed pergola in his backyard measures 12' x 75'.) At the HRC, more than 2 miles of high-tensile wire is strung across the top of the structure to support vine growth. The wires are fastened to steel cross-bars that are supported by wooden posts. At each end of the pergola, the wires are fastened to braided-steel cable that is secured to end posts and corner posts. Cables attached to earth anchors serve as a counter to the direction of pull when the high-tensile wires are tensioned (Figure 2).

Site Preparation

Prior to construction, we spread woodchips across the orchard site to serve as a mulch that would help retain soil moisture, moderate soil temperature, prevent soil erosion, promote root development, and effectively impede weed growth. Spreading this mulch *before* the posts were installed made uniform distribution much easier. A 4" layer of woodchips will typically last for 3 to 4 years before it needs to be replenished. When transplanting vines, scrape away the mulch before digging in order to avoid mixing the woodchips into the soil; otherwise the high carbon woodchips could scavenge nitrogen from the soil as they naturally decompose, creating a nitrogen deficiency for the vines.

Post and Cross-bar Installation

The HRC pergola structure runs parallel to a chain-link fence, which we used as a baseline for post installation. To ensure that layout was square, we measured the diagonal corner-to-corner distances with a tape. Once we were satisfied with the alignment, we used wire survey flags to mark the locations of the posts.

We spaced 45 10' x 5" pressure treated, round, wooden support posts 15' apart down the row and 21' apart (for cross-bar support). We installed these posts to a depth of 42" first using a hand auger to make a vertical pilot hole then using a scissor-type post-hole digger to enlarge the hole.[2] We marked the 42" depth on the shafts of both of the excavation tools with bright-colored tape. To keep the soil from sticking to the metal and to make digging easier, we periodically dipped both the auger bucket and post-hole digger clam shells in a bucket containing vegetable oil. We used a nylon toilet brush to quickly remove any soil that adhered to the steel between dippings.

[2] A scissor-type post-hole digger is hinged in the middle of the tool rather than at its base and produces a vertical hole, rather than one that is conically flared toward the ground surface.

Once the holes were dug, we dropped the tapered end of the post into the hole and used a level to make sure the post was vertical. We scraped some soil back into the hole and mounded up the remainder around the base of the post to further settle in around the post after rainfall events.

At each end of the pergola, we installed two round corner posts (12' x 12") and five 12' x 10" round end posts (one at the end of each row). We set these posts 4.5' deep using an auger mounted to a skidsteer. The holes were angled at about 75° (or 15° from vertical), leaning away from the pergola (Figure 3). We planted seven rows of kiwifruit beneath the pergola, spacing the end posts 7' apart.

Steel Cross-bars and Joiner Sleeves

After we set the internal posts, we notched them and installed 30 cross-bars. These were 24' x 1.5" x 2" rectangular 14-gauge galvanized steel tubes that we connected with 16" x 2" x 3" rectangular 14-gauge galvanized steel joiners (Figure 4). We used steel because it is structurally stronger than wood and will not readily deteriorate with age. We made adjustments necessary to compensate for the fact that we were building on a slope. Because treated wood can be highly corrosive to galvanized steel, we placed an adhesive membrane (ProtectoWrap) across the notch so the wood was not in direct contact with the metal. We used inverted U-shaped steel brackets and stainless steel screws to secure and stabilize the cross bars.

Steel Cable and Earth Anchor Tie Backs

We used 0.75" diameter braided steel (remnants from high tension cable median barriers that the Minnesota Department of Transportation uses on roadways) from a supplier who cut the cable to specified lengths. This cutting was very helpful, as the cable is quite stiff. Double-wrapping it around the corner posts proved challenging. We used a specialized clamp to hold the cable while it was tensioned by a ratcheting come-along, then we secured it with large fencing staples. We wrapped tie-back cables used to counter around the post and then tensioned and secured the cables to 4' earth anchors. All cables were double-clamped using two 5/8" cable clamps for each cable-loop. The earth anchors had been screwed into the ground and positioned so that the connecting cable would extend approximately 45° relative to the long-axis of the post (Figure 5).

High-tensile Wire

We used a spinning jenny to spool out 48 strands (totaling more than 12,000') of 12.5-gauge, high-tensile, Type 3 galvanized steel wire. The spinning jenny holds and unspools the wire coil to prevent it from kinking. The

Figure 4. A joiner sleeve connects the 24' sections of galvanized tubular steel and is clamped to a notched support post. A specialized membrane prevents the steel and clamp from coming in direct contact with the wood. The overhead high-tensile wires are secured in place using nylon clips secured here to the joiner.

Figure 5. Two earth-anchor tiebacks stabilize each corner post and prevent it from shifting when the high-tensile wires are tensioned. Each cable is double-clamped to nearly eliminate the potential for slippage.

Figure 6. A short wire loop connects the wire to the braided-steel support cable. The wire strainers enable the high-tensile wire to be tightened or loosened. The 5/8" cable clamps keep the wire loop from slipping across the cable as tension is applied to the wire.

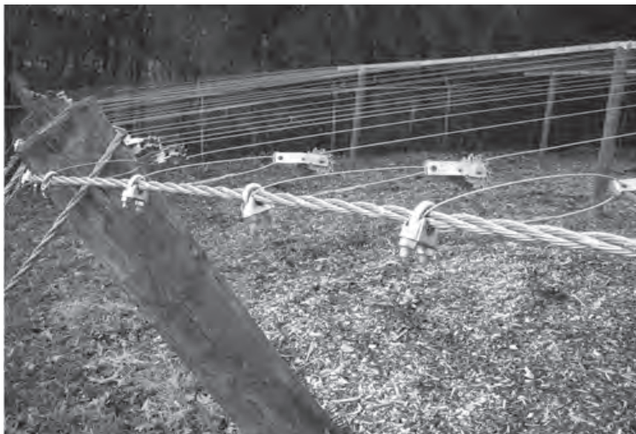


Figure 7. The kiwifruit plants growing under their new pergola at the HRC.

wires crossed the top of the cross-bars. The wire was looped around and secured using crimping sleeves and fastened to a small loop of high-tensile wire using wire-strainers. We found it helpful to use paint crayons to mark the positions of each wire loop/wire strainer combination before it was secured to the cable. Where the high-tensile wire groups crossed the steel cross-bars, we secured them with specialized nylon clips. Similarly, a special nylon clip snaps onto the high-tensile wire to keep the vine's support stake in position.

The 48 wire runs were mostly spaced about 15" to 16". Over the kiwifruit, we spaced them about 8" apart to allow for a higher planting density within the rows. This kind of layout will enable us to grow up to 500 vines on the HRC pergola. However, this double-planting approach also has potential benefits for the home or commercial growers, as the vine density can be doubled to increase fruit production in the first few years after planting. Once the vines are established and the vines are approaching full-production, some of the plants can be removed.

We held a field day in August 2009. Our press releases captured the media's attention and generated coverage in newspapers, on radio and television, and on all these media outlets' websites. Nearly 50 people attended the event, where they learned about growing cold-hardy kiwifruit, tasted some of the fruits, and saw various trellising alternatives, including the pergola. There has been considerable follow up interest since the event. The information we distributed at the field day is available on the web at *http://fruit.cfans.umn.edu/Kiwifruit/index.htm*

Terracing Kiwi

Not far away from the HRC, another method of growing cold-hardy kiwifruit is taking shape. Eric Theship-Rosales is a master shipwright and has applied these skills as he develops a kiwifruit orchard at his farm. Eric's Chanhassen orchard is located on a steep northeast-facing hillside, which is nearly ideal for kiwifruit, as it naturally shields the vines from the prevailing southwest winds during the growing season, offers good air drainage, and protects the trunks from winter sunscald injury.

Although the hillside is steep, Eric has diminished the potential for soil erosion by building 20 irrigated, 1.5' high steps, or terraces. The terraces are about 4' wide and range in length from 40' to 140'. The result is something that resembles an outdoor amphitheatre!

He has also planned an ingenious training system for the vines in his orchard. Rather than using pressure-treated wooden posts for the vine support structure, Eric is growing trees and has devised a specialized collar that will fit around the trunk and accommodate additional growth. Trellising wire will run from tree collar to tree collar, spanning the length of each terrace. At a field day in August, Eric showed visitors an elaborate, three-dimensional foam-board model that explained his orchard layout (Figure 9).

Eric has planted 300 kiwifruit vines and plans to add 500 more. He is top dressing the plants with compost to increase the amount of available organic matter and using woodchip mulch to help retain soil moisture and reduce weed competition.

Survival of newly planted vines was quite high – over 95%. Eric is growing the two cold-hardy species described at the beginning of this article, *A. kolomkita* and *A. arguta*. He is testing several other varieties as well, in order to determine which consistently performs best in his orchard. Once this is known, he would like to have two 1-acre blocks in production.

Figure 8. At our field day, visitors saw the newly-constructed pergola structure and tasted various varieties of kiwifruits.

Figure 9. Eric constructed an elaborate model of his kiwi orchard.

Predation by deer during the growing season and by rabbits in the winter has been problematic because young vines are particularly vulnerable to this type of damage. However, according to Eric, the local deer population appears to be dwindling with increased urban encroachment, and he is constructing individual wire cages to prevent rabbit injury.

Eric is in the process of standardizing his irrigation system and is doing some experimentation with the tree-wire-ground connections. He plans to continue growing cold-hardy kiwifruit and hopes to plant an additional 300 vines in 2010. He really likes the crop because the berries are quite delicious and he believes that kiwifruit will prove valuable to farmers and consumers in the not too distant future. He also thinks that the terraced-hillside growing of cold-hardy kiwifruit might bring land considered marginal or unsuitable for most other crops into production in a commercially-viable manner. Eric is really looking forward to harvesting and marketing his first crop so that others can enjoy this wonderful tasting and highly nutritious berry.

Summary

Cold-hardy kiwifruit growing in Minnesota has a promising future. For those interested in learning more about this niche-market crop, please feel free to contact project cooperators Eric Theship-Rosales, Bob Guthrie, or Jim Luby.

Management Tips

1. For kiwifruit, choose a partially shaded, sheltered location with rich, well drained but moisture retentive soil that is neutral or slightly acid in pH. Gentle north and east facing slopes are preferred, as are woodlots, windbreaks, or shelter belts that will provide shelter from strong winds.

2. Round posts are structurally stronger and cost less than square posts.

3. To keep soil from sticking while digging post holes, occasionally dip tools in vegetable oil.

4. If using trees as trellising posts, make sure the collar (that the trellising wire attaches to) doesn’t damage the tree and can accommodate the tree as it grows in diameter.

Project Location

The HRC site is located in Victoria, MN near the Minnesota Landscape Arboretum. Travel 0.3 miles northwest of the intersection of MN State Hwy. 5 and Rolling Acres Rd.

The Theship-Rosales farm is located about 4 miles south and east of the Minnesota Landscape Arboretum on Audubon Rd., approximately 1 mile south of MN State Hwy. 5.

Other Resources

Growing kiwifruit. 1995. Oregon State University. Available at: *http://extension.oregonstate.edu/catalog/pdf/pnw/pnw507.pdf*

How to build fences with USS Max-10 200 high-tensile fence wire. 1980. United States Steel, Pittsburgh, PA, 75 pp. (Out of print but some of the information it contains is available at: *www.kencove.com/Guide.php*)

Kiwifruit Web Page. University of Minnesota. *http://fruit.cfans.umn.edu/Kiwifruit/index.htm*